

Acoustic Reduction of Flow Separation, Phase II

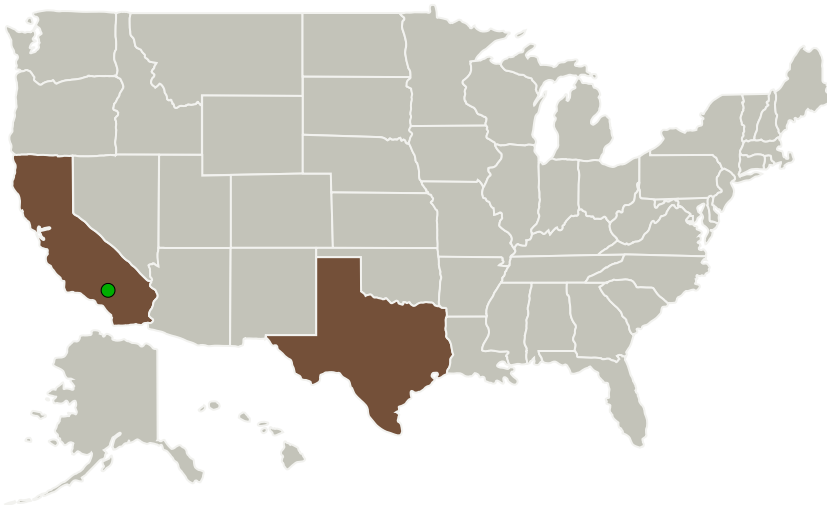
Completed Technology Project (2011 - 2013)



Project Introduction

Airfoils produce more lift and less drag when the boundary layer is attached to the airfoil. With most aircraft there are combinations of airspeed and angle of attack where the boundary layer at least partially detaches from the airfoil. Reducing boundary layer detachment increases lift and reduce drag reducing fuel consumption and improving control for the pilot. Two methods known to improve boundary layer attachment are heating the air and supplying acoustic pressure at an airfoil dependent frequency. In Phase I we demonstrated that thin ($<50\text{ }\mu\text{m}$) ribbons made from carbon nanotubes can be used to produce heating elements which can be heated and cooled hundreds of times per second. When properly located on the surface of a wing they can maximize boundary attachment as demonstrated by improvements of up to 20% in lift. In Phase II we will improve our understanding of the function of these thermoacoustic elements and demonstrate their durability and their effectiveness with larger components. In Phase I we demonstrated multifrequency sound generation on surfaces in a wind tunnel using nanotube heating elements, and achieving improved lift and TRL 3. Phase II will include medium scale wind tunnel tests verifying the effects and achieving TRL 5.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Lynntech, Inc.	Lead Organization	Industry	College Station, Texas
● Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California
The University of Texas at Dallas	Supporting Organization	Academia	Richardson, Texas

Primary U.S. Work Locations

California	Texas
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Project Transitions

▶ **July 2011:** Project Start

✓ **July 2013:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138650>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Lynntech, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Alan Cisar

Co-Investigator:

Alan Cisar

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Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.8 Ground and Flight Test Technologies

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System